

Claims

1. A method of detecting the presence or measuring the quantity of a target analyte in a sample reagent comprising the steps of:

contacting a microfabricated electrochemical biosensor with the sample reagent, the microfabricated electrochemical biosensor comprising:

(a) a substrate; and

(b) at least two electrically conductive electrodes fabricated on the substrate by integrated circuit technology, each of the electrical conductive electrodes consisting of a single layer of an electrically conductive material;

containing the sample reagent in contact with the conducting electrodes;

measuring a electrical signal output from the microfabricated electrochemical biosensor; and

determining from the signal output the presence and/or quantity of the target analyte in the sample reagent.

2. The method of claim 1 wherein the electrochemical biosensor further comprises an adhesive underneath each of the electrodes, the adhesive allowing for better adhesion of each of the electrodes to the substrate.

3. The method of claim 2 wherein the sample reagent is a biological fluid containing macromolecules.

4. The method of claim 2 wherein the sample reagent is a biological fluid containing ionic molecules or atoms.

5. The method of claim 2 wherein the substrate is selected from the group consisting of silicon, gallium arsenide, plastic and glass.

6. The method of claim 2 wherein the substrate comprises a material made out of silicon.

7. The method of claim 2 wherein the electrically conductive material is selected from the group consisting of gold, aluminum, chromium, copper, platinum, titanium, nickel and titanium.

8. The method of claim 2 wherein the electrically conductive material is gold.

9. The method of claim 2 wherein the adhesive is selected from the group of consisting of chromium, titanium, and glue.

10. The method of claim 2 wherein the adhesive comprises chromium.

11. The method of claim 2 wherein the substrate further comprises a well structure containing at least one of the electrodes.

12. The method of claim 2 wherein the electrochemical biosensor comprises at least three electrically conductive electrodes.

13. The method of claim 12 wherein each of the electrically conductive electrodes consists of a single layer of gold.

14. The method of claim 2 wherein the step of determining from the signal output the presence and/or quantity of the target analyte in the reagent further comprises the steps of:

calibrating the electrochemical biosensor with a first calibrating solution that contains a known amount of the target analyte to be detected and a second calibrating solution that contains an undetectable amount of the target analyte to be detected;

obtaining a reference signal output; and

comparing the reference signal with the measured signal to determine the presence and/or quantity of the molecules in the sample reagent.

15. The method of claim 14 wherein the substrate is selected from the group consisting of silicon, gallium arsenide, plastic and glass.

16. The method of claim 14 wherein the electrically conductive material is selected from the group consisting of gold, aluminum, chromium, copper, platinum, nickel and titanium.

17. The method of claim 14 wherein the electrically conductive material is gold.

18. The method of claim 14 wherein the adhesive is selected from the group of material consisting of chromium, titanium, and glue.

19. The method of claim 14 wherein the substrate further comprises a well structure underneath at least one of the electrodes.

20. The method of claim 14 wherein a surface on at least one of the electrodes is surface modified for anchoring macromolecules on the surface.

21. A method of detecting the presence or measuring the quantity of at least one molecule in a sample reagent comprising the steps of:

contacting a microfabricated electrochemical biosensor with the sample reagent, the microfabricated electrochemical biosensor comprising:

(a) a silicon substrate; and

(b) three electrically conductive electrodes fabricated on the substrate by integrated circuit technology, each of the electrically conductive electrodes consisting of a single layer of gold;

containing the sample reagent in contact with the conducting electrodes;
 measuring a signal output from the microfabricated electrochemical biosensor; and
 determining from the signal output the presence and/or quantity of the molecules in the sample reagent.

22. A microfabricated electrochemical biosensor comprising:

a silicon substrate; and

three electrical conductive electrodes for redox sensing fabricated on the substrate by integrated circuit technology, each of the electrical conductive electrodes consisting of a single layer of gold.

23. A method of detection of a target analyte comprising the steps of:

providing a biosensor and at least one reagent, the biosensor comprising:

(a) a first area having a first surface property for immobilizing the target analyte contained in the reagent; and

(b) a second area having a second surface property different from the first surface property so that a sample of the reagent can be confined due to surface tension forces between the first area and the second area, the second area comprising components for detection of the target analyte;

applying a volume of reagent to the biosensor, wherein the coverage of the reagent over the biosensor is controlled by the volume of the reagent and the surface tension forces; and

detecting a presence and/or measuring a quantity of the target analyte by the biosensor.

24. The method of claim 23 wherein the components comprise at least one electrode selected from the group consisting of a counter electrode and a reference electrode.

25. The method of claim 23 wherein at least one reagent comprises a first reagent and a second reagent.

26. The method of claim 25 wherein the step of applying reagent to the biosensor comprises the steps of:

covering the first reagent over the first area; and

covering the second reagent over the second area.

27. The method of claim 26 wherein the first area is shaped in a first geometry that is designed to confine the first reagent within the first area.

28. The method of claim 27 wherein the second area is shaped in a second geometry that is designed to confine the second reagent with the second area.

29. The method of claim 25 wherein the first reagent is a biological fluid containing the target analyte and the second reagent is a chemical solution suitable for biological detection of the target analyte.

30. The method of claim 23 wherein the target analyte is selected from the group consisting of ionic molecule and macromolecule.

31. The method of claim 23 wherein the step of detecting the presence and/or quantity of the target analyte further comprises:

calibrating the biosensor with a first calibrating solution that contains a known amount of the analyte to be detected and a second calibrating solution that contains an undetectable amount of the analyte to be detected; and

utilizing the calibration results to detect the presence a quantity of target analyte in the reagent.

32. The method of claim 23 wherein the surface properties of the first and second areas are surface modified before application of reagent to the biosensor.

33. The method of claim 23 wherein the surface properties of the first and second areas are controlled by an external force field.

34. A device for detecting a redox event of at least one analyte in a liquid reagent comprising:

a redox sensor fabricated on a semiconductor by using at least one of integrated circuit (IC) and micro electromechanical systems (MEMS) technology, the redox sensor includes at least two electrically conductive electrodes for signal output and bias control;

an isolation layer between the electrodes and the semiconductor;

an integrated circuit (IC) on the semiconductor and underneath the isolation layer, the integrated circuit comprising a detection circuit and a bias potential circuit for providing a bias potential to the detection circuit; and

wherein the isolation layer has a electrically conductive contact portion for electrically connecting the electrodes with the integrated circuit (IC).

35. The device of claim 34 wherein the electrically conductive electrodes are selected from the group of materials consisting of gold, aluminum, chromium, copper, platinum, nickel and titanium.

36. The device of claim 34 wherein the electrically conductive electrodes are made out of gold.

37. The device of claim 34 wherein the semiconductor is selected from the group consisting of silicon and gallium arsenide.

38. The device of claim 34 wherein the semiconductor is silicon.

39. The device of claim 34 wherein the detection circuit comprises a current measurement device to detect a current signal from the redox event through a corresponding electrically connected electrode.

40. The device of claim 39 wherein the bias potential is a potential difference between at least two different electrodes to enable electron transfer for current detection.

41. A device for detecting a redox event of at least one analyte in a liquid reagent comprising:

a redox sensor on a semiconductor, the redox sensor comprising a reference electrode, a working electrode and a counter electrode;

an isolation layer between the redox sensor and the semiconductor;

an integrated circuit (IC) on the semiconductor and underneath the isolation layer, the integrated circuit comprising a detection circuit and a bias potential circuit for providing a bias potential to the detection circuit; and

wherein the isolation layer has a electrically conductive contact portion for electrically connecting the electrodes with the integrated circuit (IC).

42. The device of claim 41 wherein each of the electrodes consists of a single layer of electrically conductive material.

43. The device of claim 42 wherein the electrically conductive material is gold.

44. The device of claim 43 wherein the semiconductor is silicon.

45. The device of claim 44 wherein the detection circuit comprises a current measurement device to detect a current signal from the redox event through a corresponding electrically conductive electrode.

46. The device of claim 45 wherein the bias potential is a potential difference between at least two different electrodes to enable electron transfer for current detection.

47. The device of claim 41 wherein the semiconductor is selected from the group consisting of silicon and gallium arsenide.

48. The device of claim 41 wherein the semiconductor is silicon.

49. The device of claim 41 wherein the detection circuit comprises a current measurement device to detect a current signal from the redox event through a corresponding electrically conductive electrode.

50. The device of claim 49 wherein the bias potential is a potential difference between at least two different electrodes to enable electron transfer for current detection.